Center Independent Research & Development: GSFC IRAD

Radiation Hardened CAN-to-I2C/SPI ASIC (RH-CAN)

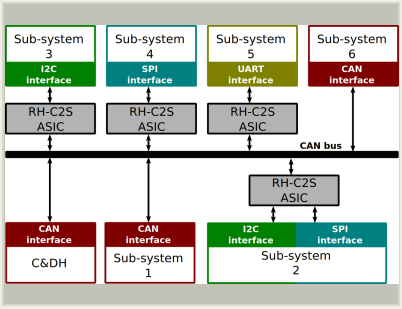
Completed Technology Project (2016 - 2017)

Project Introduction

This effort seeks to develop a rad-hard CAN-to-I2C/SPI (Controller-Area Network to Inter-Integrated Circuit and Serial Peripheral Interface) ASIC for efficient and robust communication in miniaturized instruments and small spacecraft. NASA has been relying on serial interfaces such as I2C and SPI which provide simple solutions at the component and sub-system level, however, their limited expandability and lack of error detection lead to problems when used for complex system and spacecraft level communications which are only found in integration with limited time and options to address them. The CAN-to-I2C/SPI ASIC seeks to enable full CAN-based systems where I2C and SPI devices are isolated using the converter, increasing efficiency by reducing the number and type of interface and reliability by improving expandability and robustness. The main objective is to design a prototype for a radiation hardened low-power CAN-to-I2C/SPI ASIC that will enable full CAN bus for future small satellites and CubeSats. The proposed device will improve efficiency and robustness of communication busses by isolating I2C and SPI components at the subsystem level. The proposed development includes coding in HDL (high level design language, e.g. Verilog) a CAN controller and I2C/SPI masters with interface logic, and prototyping in a low-cost FPGA development board. A path to silicon will be evaluated after the design is proven in the FPGA platform.

Anticipated Benefits

The ASIC reduces complexity and increases efficiency by reducing the number and type of interfaces, design time and system level problems in particular those associated with I2C. For small satellites, it will do so by enabling a single CAN-based system bus where I2C, SPI and UART sub-systems or peripherals are isolated and interfaced using the proposed device.



CAN-based bus with mixed I2C, SPI and UART

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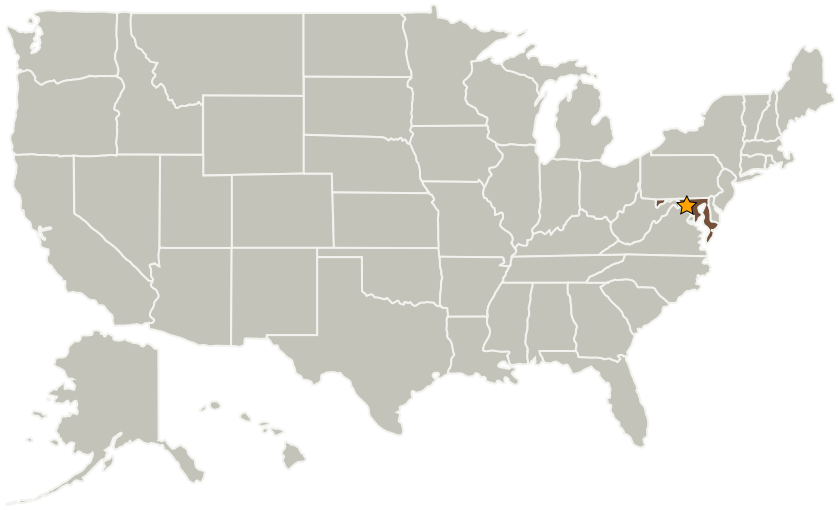
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Project Transitions

October 2016: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

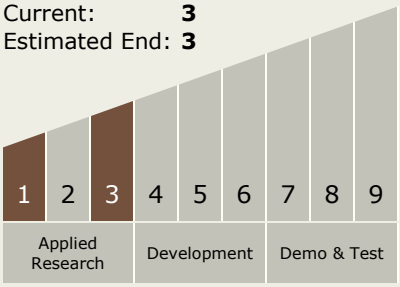
Wesley A Powell

Principal Investigator:

George Suarez

Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **3**



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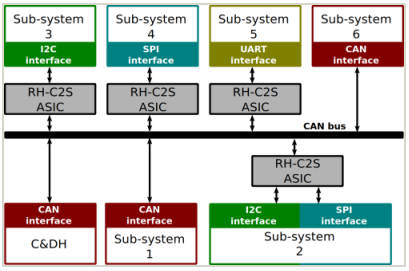
September 2017: Closed out

Closeout Summary: The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services. Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry. The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies. If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. http://techport.nasa.gov/help

Images



CAN-based bus with mixed I2C, SPI and UART
CAN-based bus with mixed I2C, SPI and UART
(https://techport.nasa.gov/image/101151)

Technology Areas

Primary:

- TX02 Flight Computing and Avionics
  - TX02.1 Avionics Component Technologies
    - TX02.1.6 Radiation Hardened ASIC Technologies

Target Destinations

Earth, Others Inside the Solar System, Outside the Solar System